Professional Aquaculture Services

Conway Ranch Aquaculture Site Evaluation and Plan

Contact: tvaught@proaqua.com

Tony S. Vaught

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AQUACULTURE
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Contents

Introduction

The interest in the private production of fisheries products through aquaculture has seen unprecedented growth over the past 20 years. This growth is due to many factors which include; increased worldwide consumption, low supply due to environmental impediments, increase in recreational fishing pressures, and variable state and federal hatchery programs. The challenge, therefore, is to continue to meet the demand created by population growth while keeping environmental and financial sustainability in balance.

Recently, the number of commercial fish farms, both land-based and offshore, in almost all other areas of the world has out-stepped the growth of that in the United States. This current underperformance by the United States is largely due to regulatory impediments, financial constraints, and the lack of federal and state funding support. As a result, the supply of domestically produced fish must increase in order to keep prices within reach of the consumer. To accomplish this, the U.S. must significantly intensify aquaculture research, identify environmentally responsible resources appropriate for fish production, and support private business through research grants and low interest loans. Progress can be made not only by utilizing known production techniques and research that has been done elsewhere, but also by looking to new techniques using the resources available.

The question remains, however, where and how can this be done?

Each site evaluated for aquaculture has limitations and assets specific to the production of product. Primarily, these limitations are political, economic, or environmental in nature. Technology exists to solve environmental concerns; however, the challenge, then, often becomes financial. Political opposition has halted environmentally and economically sound projects even at the expense of improved prosperity of the community. As a solution, community involvement with regard to the project is essential.

Integrating a variety of environmentally different production areas, species, and research projects can help to focus on the production of fish for food and recreation.

The impacts on natural stocks of fish, despite increased fisheries management and regulation, have diminished the fishing success of anglers. This has directed the search for recreation away from fishing. The cost of fishing licenses, the complexity of regulations, and the success rate have all had an influence. Public stocking programs must modify stocking and production goals to meet environmental and political goals that, all too often, have negative impacts for anglers.

The public/private partnership allows for more flexibility and the opportunity to bring in entities to cooperate on the goal of providing not only catchable fish, but other fish to meet consumer demand mentioned above. This can be done in tandem with research on at-risk fish species and varieties of native fish that may be able to be produced to help meet the demand.

The goals of a program and plan outlined in this report are as follows:

I. Provide recreational fish desirable to the public to assure improved and sustained angling success.
II. Further research on native varieties of fish.

III. Protect and promote wildlife habitat and improve conditions and opportunities on the ranch for anglers and non anglers to enjoy.
IV. Inform and educate the public.

Site overview

Information is reviewed to identify the site potential, resources, and problem areas. Several key areas determine the success, profitability, and longevity of an aquaculture operation. Each area is linked to the other by financial, managerial, and biological components. Tying these components together creates a clearer picture of the business and assists in improving efficiency and developing plans for growth. Key components include location, permitting, water quality and quantity, water discharge and waste removal, appropriate species, stock sources, physical security and bio-security, and, most importantly, financial sustainability with sound marketing and business practices.

The Conway Ranch property (811 acres overall) was purchased by Mono County with grant funds from several funding sources in 1998 and 2000. In general, the purposes of these grants are to protect and preserve the natural, open space, scenic, historic, and public access values of the property in perpetuity, while allowing for the continuation of the existing fish-rearing, sheep grazing, and public access. Grant Agreements were signed by Mono County and each of these funding agencies, obligating the County to the protection of these values as a condition of receiving the grant funding. Within the aquaculture area, grants restrictions are in place for the protection of wildlife and plant habitats.

Location

The Conway is equipped with the components needed to support commercial aquaculture. The site has a history of fish production and has been successfully rearing fish under restrictions set forth by several public agencies. The sustainability of aquaculture is well documented. Production of a clean, healthy, local product with valuable byproducts on the site will improve the property aesthetically, while also stimulating commerce.

The climate for the majority of the year is conducive to cold and cool water fish. It should be noted, however, that drought conditions, extreme heat, as well as severe cold can limit and modify production. Securing a consistent supply of water is the best insurance to guard against these extreme conditions. Oxygen delivered in the water is critical to optimum growth. Higher temperatures can limit oxygen and severe cold can interrupt the flow of water; both conditions have the potential to starve fish of oxygen. Oxygen generators, which are being utilized in many remote locations to increase production and to guard against severe weather, may be required at this location.

Access and proximity to markets and supplies is an important economic factor. The site is relatively close to the market, which consists primarily of recreational lakes and streams , local restaurants and stores. Some of the locations are remote with limited access. Specialized transport trucks are needed to deliver to these remote locations. The site is close to major highways, where regular truckloads of fish feed are transported to state and federal hatcheries in the area.

Existing Infrastructure

Water supply structures, although recently improved, are inadequate. Also, screen maintenance is a major drain on personnel time. The current screens can be improved to self clean, which can guard against water flow restrictions due to debris as well as ice formation. Water control gauges and weirs should be improved to regulate and manage the flow of water. Raceway screens can be redesigned for ease of maintenance.

Electrical power has been installed on the property. Underground electrical lines should be extended to serve oxygen generators, aerators, and water pumps. Backup power should be installed to guard against power interruption.

The existing raceways that were constructed under restrictions, although well-designed and functional, have limited production due to the need to use existing ditches. As a solution, the existing raceways could serve an important function in combination with improved raceway and tank systems. The existing raceways can be used for fish conditioning before delivery, broodstock management, short term fish holding, and to spread out fish in lesser densities for overwintering. In addition, low flow raceways with oxygen enhancement can be used for other native fish production.

Other additional concerns are: There are limited support structures for storage, vehicle and equipment maintenance and decontamination, housing and office facilities. There are no facilities for hatching or rearing fingerling on the site. Feed storage is limited to modified storage containers. These containers are sufficient for bagged feed; additional bulk storage is recommended to help reduce feed costs and labor.

Risk Protection

One of the major risks at this location is upstream water contamination. The risk of leakage of contaminates from the power plant needs to be assessed and safeguards addressing contamination from highway accidents must be taken into consideration. Threats from vandalism to the water supply due to contamination or diversion of water are significant. All risk cannot be guarded against, securing the water control valves that are accessible to the public is imperative. Containment structures adjacent to highway drainage will limit contamination of the water source from highway accidents. Highway contaminants and vandalism is an immediate action item.

The site is subject to weather events including high winds, rain, snow, and extreme cold. Storms can be intense in the area during winter months. Appropriate safeguards, with appropriate backup power for extended outages, must be in place to protect outdoor areas and buildings against these events. Power, water, and the movement of water are the lifeblood of any aquaculture facility. The facility must run independent of any interruptions of power and water. Flow alarms and safeguards against water supply ice dams must also be in place.

Facility and stock insurance is available for catastrophic events; however, without proper risk management, costs can be high for protection. The aquaculture industry is relatively new to the insurance community and has unknowns related to disease and other business interruption factors. These unknowns are currently in the process of evaluation; however, risk factor multipliers are not available due to the diversity of products and sites. Protection may be expensive or unavailable for certain components of risk.

Permitting

The permitting process is undoubtedly the most expensive, unpredictable, and time-consuming portion of any aquaculture site. The process involves many different and overlapping agencies and groups, often with conflicting agendas and regulations. The site has several challenges in this arena that may initially complicate the improvements; however, each agency and group has the opportunity to utilize the resources for a number of beneficial and coexisting activities. This rare intersection of benefits has the ability to bring visitors and create jobs in all sectors, including tourism, aquaculture, and environmental stewardship. Some examples of positive interactions include:

I. A long history of public and private of fish production.
II. A community awareness of aquaculture and the need for economic development through recreational fishing.
III. Local, state, and federal government approval and encouragement to pursue aquaculture uses that coexist with wildlife and the public.
IV. Approved permits for the existing private growers.

The final determination of whether or not to move forward with improvements to a facility often comes down to the time and expense of agency, environmental, and land use permit approval. When this process is extended and costly, other sites that are environmentally and regulatory friendly are considered. A site Programmatic Environmental Impact Report (PEIR) or master permit is helpful to attract supporters and funding of an aquaculture production and interpretive center. The cost development of a site PEIR for aquaculture may be shared through local, state, and federal economic development funds. Since this is the largest impediment to aquaculture development in the U.S., an approved site plan will attract supporters due to ease of entry and reduced cost and risk of permit denial late in the process.

Water Supply

Water quantity, quality, and cost are often telling when evaluating a site for aquaculture. During a site evaluation it may be realized that other impediments overshadow the lure of abundant high quality water. The site has two water sources available. I will address each separately.

I. Untreated freshwater: The untreated freshwater is undoubtedly the most abundant and available source for the site. The delivery infrastructure needs improvement and the supply is variable due to seasonal supply and multiple uses of the water. The water quality has proven to be adequate for cold water fish production although, due to cold temperatures, winter production is limited. Surface water poses several risks not associated with well or purified water, including disease from fish in the wild, contamination from upstream activities, temperature variation, and turbidity. Changes in supply agreements due to unforeseen environmental changes (drought, fisheries, and endangered species impact) can occur. Many state and federal facilities rely on surface water. New technology has improved the options for water disinfection and treatment. Most flow-through surface water facilities need extensive water treatment and disinfections processes to operate. The most successful flow-through farms use spring water that is of excellent quality and consistent in temperature and flow. These sites, however, are difficult to find and secure.

II. Ground water: A small test well is present on the property and water quality tests and monitoring are underway. The quantity, quality, and temperature of this source are unknown and need to be investigated. The aquifer may contain an abundant supply of water. Additional wells need to be a top priority to secure an alternate source of water during drought years and to secure water with a consistent temperature for hatchery, fingerlings and the overwintering of trophy fish. Additional wells and the enhanced use of current wells for aquaculture would be developed based on analysis under the California Environmental Quality Act and that surrounding wetlands and water supply systems will not be negatively impacted by groundwater extraction.

III. Water is the key element of any aquaculture site. There are limited sites available for aquaculture that have access to the quantity and quality of water such as the Conway site. Securing and improving surface water while developing alternate sources of water from wells make the Conway location an excellent choice for expansion. Aquaculture is a non-consumptive use and the resource can be used downstream for wetland development, recreation, and agriculture as well as provide much needed water for downstream natural bodies of water. Fish production, conventional agriculture, recreation as well as fauna and flora habitat can coexist when well managed. The key is to centralize communication and management so all parties are engaged and informed. Existing grant requirements must be satisfied while immediate improvements to secure the water source is implemented.

Tail Water Management

Tail water management and discharge permit requirements are becoming a larger concern in aquaculture production. In many places in the nation, flow-through systems are limited in their production due to water discharge limitations. The amount of fish fed as well as natural and mechanical waste removal are important factors to evaluate when establishing a new site or improving an existing facility.

In the case of the Conway Ranch, the tail water resource for the entire facility must be evaluated. All growing aquatic animals produce waste. Many of the waste products can be reduced by treatment processes and permitted for beneficial downstream uses. Freshwater solids may have value as fertilizer and may be incorporated into neighboring soil enhancement products. Fertile water is now being viewed as a resource rather than a pollutant. There are numerous examples of wildlife and agriculture benefiting from this resource.

At this time, runoff water from the facility supplies water for grazing irrigation, wetlands, and Wilson creek. Developing a strategy to utilize water for multiple downstream uses will help set production goals in line with these uses. The location of the property is ideal for use of the tail water resource without additional pumping. If designed correctly, the system can run with minimal management. This will reduce labor costs, while also efficiently utilizing the water. In addition to environmental benefits, a managed recreational stream fishing venue could bring in additional income over and above wetland mitigation bank monies.

Improvements

The following improvements are recommended to bring the facility into full production and to provide greater public access and use. These items are not in order of importance; however, I have indicated in my descriptions the items that need immediate attention. All structures should be designed to depict the historic uses of the ranch such as replicas of historic barns in the area, non reflective materials and natural landscaping. Production areas can be constructed to be hidden or to blend into the topography.

Water control and screening: All water regulation boxes and weirs need to be redesigned and improved to facilitate cleaning, meet DFW specifications and measure water delivery. By installing proper screens, maintenance is reduced and a proper barrier is established to prevent the introduction of wild fish. In addition, water flow and control can be recorded for use in production, stream flow regulation, and tail water resources uses. Designs will be specific to each location and the need for regulation and debris removal.

Backup wells: Installation of a minimum of three new irrigation wells located in areas that provide the maximum flow and elevation to serve the two major existing production areas, the proposed new hatchery and production units is recommended. Test the existing well for water flow and evaluate its use for a hatchery building. This will establish a backup source of water and provide for temperature regulation. In addition, systems using strictly well water can be used for the hatchery and offer bio-control against disease and contamination from surface waters. This is an immediate action Item. Agricultural grants or funding through Southern California Edison may be available, as water flow can be impacted by power generation and other water usage.

Power distribution: An estimate of the cost of further power distribution should be completed, to extend the power to critical areas of production, support facilities, and the hatchery. Power is needed for wells, oxygen generation, predator control, security equipment, decontamination, oxygen and flow metering devices, surface aeration, shop, office, and housing. A cost estimate is an immediate action item.

All weather access roads: An all weather road must be constructed from the lower end of the property to the hatchery site in order to accommodate large feed trucks and fish transport trucks. County snow removal equipment should be available to clear roads in the event of heavy snowfall.

Interpretive center: An interpretive center will serve the public and provide educational activities at the site. A small classroom can double as a meeting place for community organizations and other public gatherings. Income can be generated for the use of this venue in certain circumstances.

Hatchery: One stationary hatchery and one mobile hatchery are needed to make the facility self-sustainable, allowing for egg and fry production for sale or cooperative programs. The mobile hatchery can be moved to different water sources for egg incubation and fry production. Temporary fry rearing tanks can also be set up in peak fish hatching seasons. The mobile hatchery can also be leased or loaned out for research projects or private production needs. A mobile hatchery can be disinfected and easily stored during down times.

Nursery: A nursery area adjacent to the hatchery will allow for fry and fingerling rearing. Conventional raceways, troughs, and circular tanks are being used in combination to allow for better bio-security and production. This site would be adjacent to, or could replace the current larger “D” raceway.

Production: Three new systems are recommended to enhance and complement existing sites to allow for diversity and production.

- **Production area 1:** is adjacent to the "C" raceways, taking off from the main water supply at the top to the facility. This can either be a raceway system, circular tank system, or a combination of both. Circular tanks may prove to be more economical and, with oxygen enhancement, more productive. They can be built at ground level, similar to the raceways, with minimal impact on site aesthetics. Circular tanks can be protected from birds and camouflaged.
- **Production area 2:** is on the back side of the float tube lake due to the elevation and the proximity to the road and wetland mitigation areas. This site is removed from the other production sites to allow for single species production such as Lahontan Cutthroats. Funding assistance may be available by cooperative programs with State and Federal fish programs for the research and production of threatened species.
- **The special projects area:** is a smaller remote system using tail water from the "A" raceways. This location has existing water delivery systems and has the elevation and fall to accommodate raceways or tanks. Water from this system can be used for an enhanced recreational stream and for wetland and pasture supply.

Recreational fishing can be improved with the addition of a managed recreational stream. This stream will provide a venue for stream fishing enthusiasts and for fly fishing instruction. It differs from the float tube or small bank fishing pond in that it offers a location for types of fishing that require a greater level of skill. Construction to allow paying recreational fishers a place to enjoy privacy with managed results will help to fund the project. Instruction on stream stewardship and fishing techniques can be taught and demonstrated.

Perch broodstock ponds are an example of coexisting projects related to other fish. The Sacramento Perch is a native fish to California. This fish is of interest to public and private aquaculturist and researchers. Cooperative programs between researchers and private fish farms have been successful in the past.

Feed storage is needed to reduce the cost and labor to handle the feed. In addition, different sizes and diets will need to be implemented for multiple programs on the site.

Farm office and housing can be combined to offer a place for recordkeeping as well as security during off hours.

UV disinfection stations are needed to guard against upstream contamination and to maintain disease certifications for stocking programs and research. Large UV system technology has improved to assure proper disinfection and operates with a lower cost and maintenance. These systems would be installed as needed with construction of a hatchery and additional production sites.

Oxygen generation is essential to meet the demands required for increased density and also to protect against low water flows. Funding may be available through Southern California Edison.

Plan and Siting

Siting considerations: When developing plans for siting it is important to consider the entire project, the opportunities, and any impediments to meeting the production goals. The development of phases that fit the needs of the market while planning for the future, establish a time line for progress that is essential. Permitting of the entire footprint of the site will allow for smooth transitions between phases and give operators and investors the confidence that there will be no unnecessary delays that will impact production goals.

The Conway site offers opportunities to have different production activities on one site that may be operated by different private or public entities. This can work well with support facilities such as maintenance, office, and storage.

Water and topography are the two most important aspects in sighting criteria. Introducing the water at the highest point of the property increases sighting options while reducing or eliminating pumping costs and maintenance. Gravity flow water should be used whenever possible.

Health and genetic bio-security will allow multiple projects for a variety of watersheds to be housed on the property. Proper safeguards against disease transmission will bring projects to the site. This includes strict security measures and restricted access to some areas. This can be difficult on property open to the public. Disinfection of boots, float tubes, nets, and fishing equipment is necessary.

Executive Summary

The resources of the site are impressive in nature and offer the possibility of several components to come together to make the site a successful production, research, interpretive and training center.

I recommend these actions:

I. Secure the existing water source from contamination and vandalism.
II. Begin the discussion with Caltrans about guarding the water source from highway accidents. Containment areas are effective.
III. Test existing well water further and obtain costs for test wells in other areas of the property to determine quantity and quality. If an adequate amount of clean well water is available, site plans can be modified to match the new water supply.
IV. Develop an alternative source of water by drilling irrigation wells on the property. This supply is useful in our current low-water year and will stabilize quality and temperature for winter production and fish incubation. Also, disinfection stations may be able to be phased in over time since well water has no disease risk associated with it.
V. Start the process of permitting the site as laid out in the master plan.
VI. Contact additional private and public fish producers to introduce the idea of cooperative production of different subspecies and varieties.
VII. Initiate a public relations campaign to inform the public of plans for the site and the benefits to the area's economy. This identifies opposition, while also building support for the project. Bringing opposing groups together early will expedite the project.

VIII. Initiate a marketing plan that includes recreational fish production, special projects, public fishing, public instruction and interpretive grants, and any other income-producing opportunities. Determine cost to benefit criteria.

IX. Develop a plan to improve the property and engage the public with regard to additional recreational fishing venues as well as recreational fishing educational training facilities. These facilities can be an integral part with respect to increasing the draw for tourism in the area by enhancing the Conway ranch both aesthetically and environmentally.

X. Evaluate the site for commercial aquaponics. The low requirement of water and the relatively low density of fish needed to drive production of a high value aquaponic vegetable farm make the site attractive. Demand for local organic products is generally high with local restaurants and grocery stores.

XI. Invite restaurateurs, and members from the culinary field to discuss local supplies and demand for fish. Pristine fish from the eastern sierra may be branded for sale in upscale restaurants throughout the west.

XII. Contact international businesses and organizations to investigate transfer of technology that may be available for application at the site.

XIII. Host a symposium to draw together local businesses, academia, and researchers from a variety of institutions in an attempt develop a strategic plan for the area. What are the area strengths and weaknesses with regard to economic impact of recreational fishing, environmental education, hiking and camping?

XIV. Research sources that will initiate progress with regard to increased fish production, development of a master plan, permitting, and public relations.

Conclusion

A multidimensional facility has the ability to produce much needed trophy fish, jobs, environmental education, and sustainable food sources for the future. The State is required, by law, to spend 33.33% of sport fishing license revenue on the Hatchery and Inland Fisheries Fund. Of these funds, the California Department of Fish and Wildlife (CDFW) is required to produce and stock 2.75lbs/year of fish per licensed fisherman in the State; of which, 2.25lbs are to be catchable size. The Department is below this production due to water shortages, disease, and elevated discharge requirements. Private contractors have been shown to produce fish for significantly less than State and Federal hatcheries. Producing fish for enhancement and recreation may be a catalyst for grant opportunities and cooperative programs.

The site offers diversity due to its unique location and the large supply of fresh water; if costs can be reduced or shared, opportunities should open up for further development. The site can be a model for the future, showcasing a partnership that offers benefits to a variety of public groups. Aquaculture is currently the fastest growing and most promising sector of agriculture and is one of the only food production systems that can grow food, enhance and protect heirloom fish, and provide a valuable recreational product. The two most significant impingements on the growth of aquaculture are the shortage of available sites and environmental constraints. Securing resources and sites for aquaculture is important to meet a growing demand.

By ignoring the opportunities at the Conway Ranch, the fate of local recreational fish lies in the hands of State fish productions sites. Diversity and options are important to a secure source of trophy fish and special fisheries projects. Partnerships between public agencies and others are best facilitated by an organizational structure that is flexible enough to capitalize on opportunity, while securing its existence, well to the future. The Conway site has the resources and topography to provide recreational and native fish for the area.

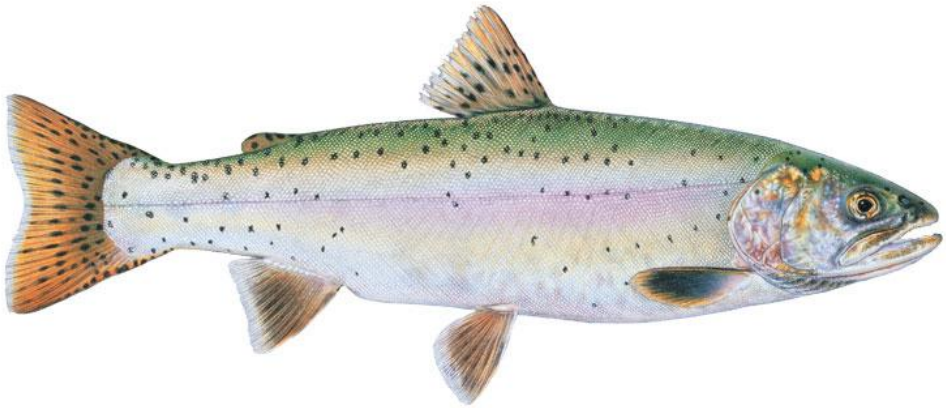
Appendices

Freshwater Species

Rainbow trout are raised privately in northern and central California. State hatcheries are spread throughout the state, located at sites established for recreational enhancement. Although a small portion of privately grown fish are marketed as food fish, the majority of public and private fish are produced for stocking. A change in the product of fish to exclusively triploid fish has taken place over the past three years in order to satisfy environmental requirements and genetic comingling of wild and hatchery raised fish.

Rainbow trout *(Oncorhynchusmykis)*

Lahontan cutthroat trout is the largest subspecies of cutthroat trout, and the state fish of Nevada. The Lahontan cutthroat is native to the drainages of the Truckee River Humboldt River. Carson River, Walker river, Quinn river, and several smaller river in the Great basin of North America, These were tributaries of ancient Lake Lahontan during the ice ages until the lake shrank to remnants such as Pyramid and Walker lake about 7,000 years ago, It is one of three subspecies of cutthroat trout that are listed as federally threatened.

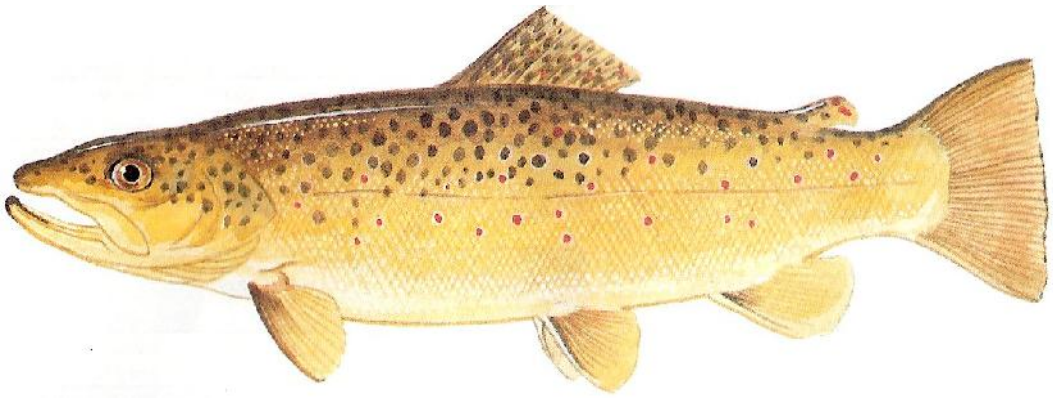


Lahontan cutthroat trout *(Oncorhynchus clarkii)*

The California golden trout is designated by the Legislature as the State Fish. They are found in Golden Trout Creek, a tributary to the Kern River, and the South Fork Kern River, which empties into Lake Isabella.

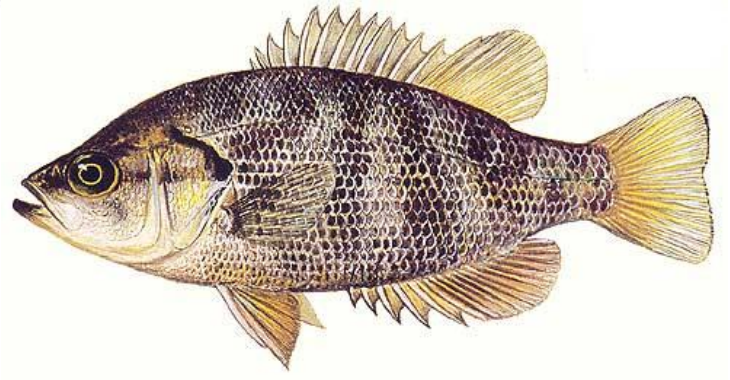
Golden trout *(Oncorhynchus mykiss aguabonita)*

The brown trout is a medium-sized fish, growing to 20 kg or more and a length of about 100 cm in some localities, although in many smaller rivers, a mature weight of 1 kg (2 lb) or less is common. Salmo trutta lacustris reaches an average length of 40-80 cm (16-32 inches) with a maximum length of 140 cm (55 inches) and about 60 pounds (27.2 kg).



Brown Trout (*Salmo trutta*

Sacramento perch were historically abundant predators throughout the Central Valley of California, where they occupied sloughs, lakes, and slow moving rivers. Today they are rare in their native waters, but still exist in Clear Lake and Alameda Creek/Calaveras Reservoir, as well as in some farm ponds and reservoirs. They have been introduced through the state including the upper Klamath basin, upper Pit River watershed, Walker River watershed, Mono Lake watershed, and Owens River watershed, and may exist in Sonoma Reservoir in the Russian River watershed. Sacramento perch are most often found in warm reservoirs and ponds where summer temperature range form 18-28°C. Sacramento perch are capable of surviving high temperatures, high salinities (up to 17 ppt), high turbidity, and low water clarity. Though Sacramento perch are often found in clear water among beds of aquatic vegetation, they achieve greater numbers in turbid lakes absent of plants.



Sacramento perch *(Archoplites interruptus*)

Alternate Aquaculture Related Businesses and Uses

Attracting complementary business in one location can serve to not only to increase income for the site but to promote cooperative research. Tying together production, research, and marketing components will strengthen productivity.

I. Research Park for the study of Aquaculture and the wild fish population.

II. Egg and fry production facility.

III. Public fishing and recreation.

IV. Aquatic and wetland learning center.

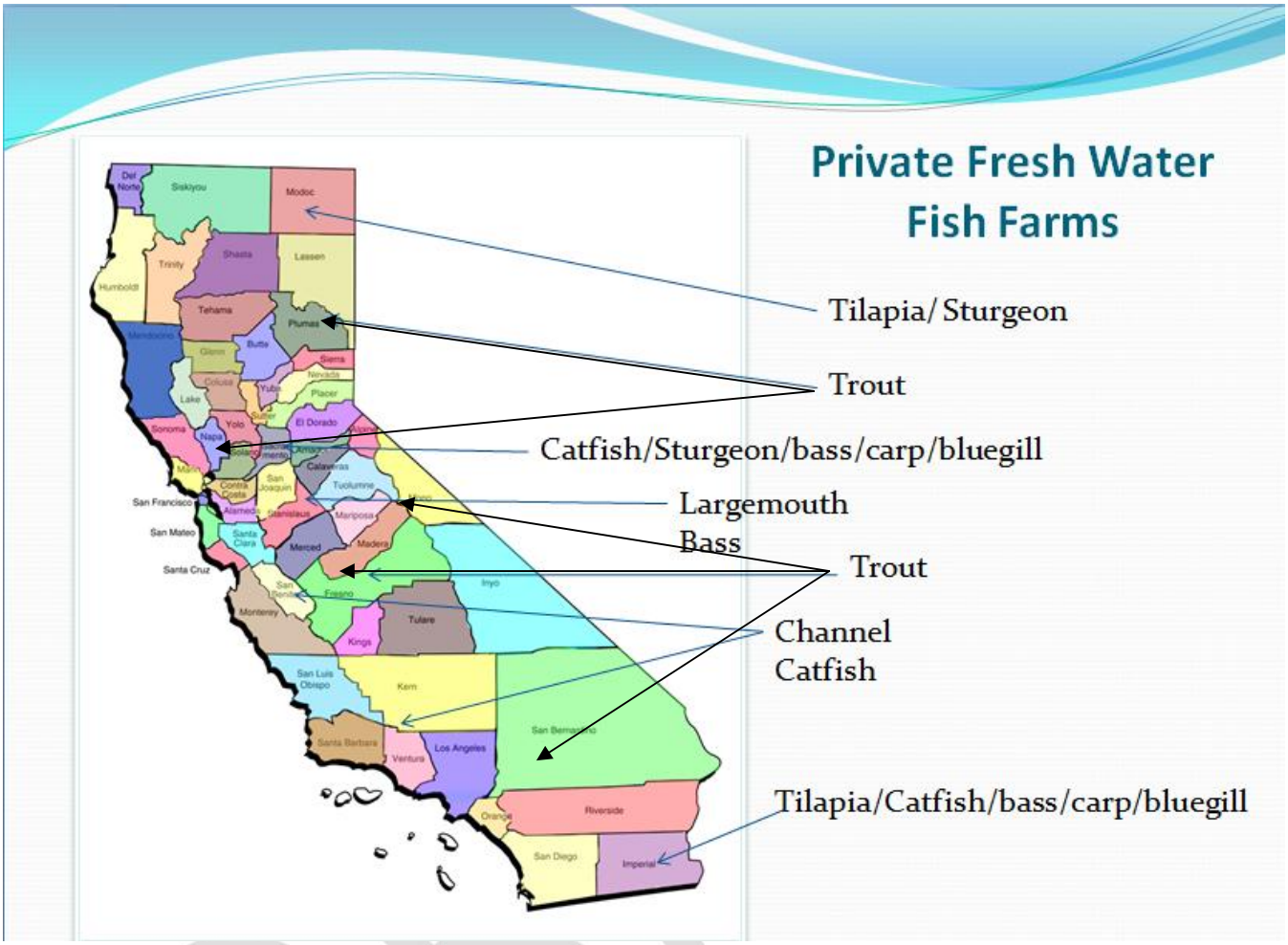
V. Wildlife viewing and study center.

VI. Interpretive center to compliment the Mono lake interpretive center.

VII. Recreational and environmental field camp for kids.

VIII. Sacramento perch hatchery and rearing facility.

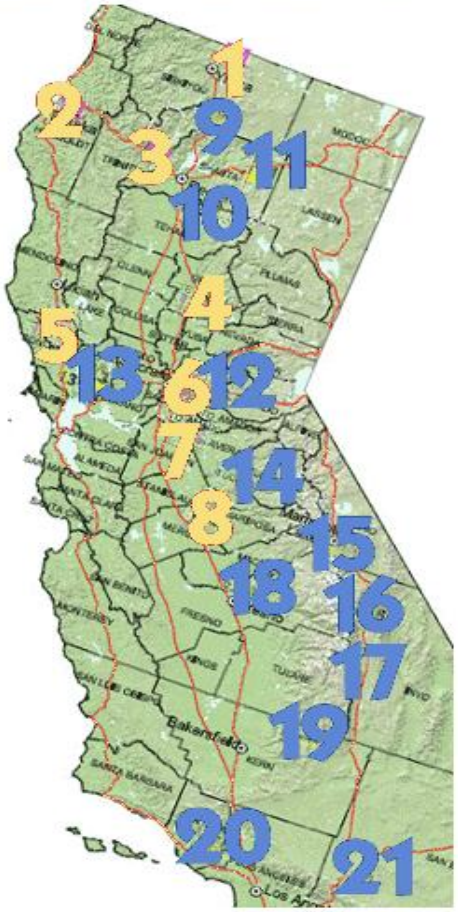
IX. Community college field station.


Private Fresh Water Fish Farms
Tilapia/ Sturgeon
Trout
Catfish/Sturgeon/bass/carp/bluegill
Largemouth Bass
Trout
Channel Catfish
Tilapia/Catfish/bass/carp/bluegill
Del Norte
Siskiyou
Modoc
Humboldt
Trinity
Shasta
Lassen
Tehama
Plumas
Mendocino
Butte
Sierra
Glenn
Colusa
Nevada
Yuba
Placer
Lake
Sutter
El Dorado
Yolo
Sonoma
Napa
Amador
Calaveras
Marin
Contra Costa
San Joaquin
Tuolumne
San Francisco
Alameda
Stanislaus
Mariposa
San Mateo
Santa Clara
Merced
Madera
Santa Cruz
San Benito
Fresno
Inyo
Monterey
Tulare
Kings
San Luis Obispo
Kern
Santa Barbara
Ventura
Los Angeles
San Bernardino
Orange
Riverside
San Diego
Imperial

California Department of Fish and Wildlife Hatchery System

Hatchery Overview | Fish Planting | Fish Counts

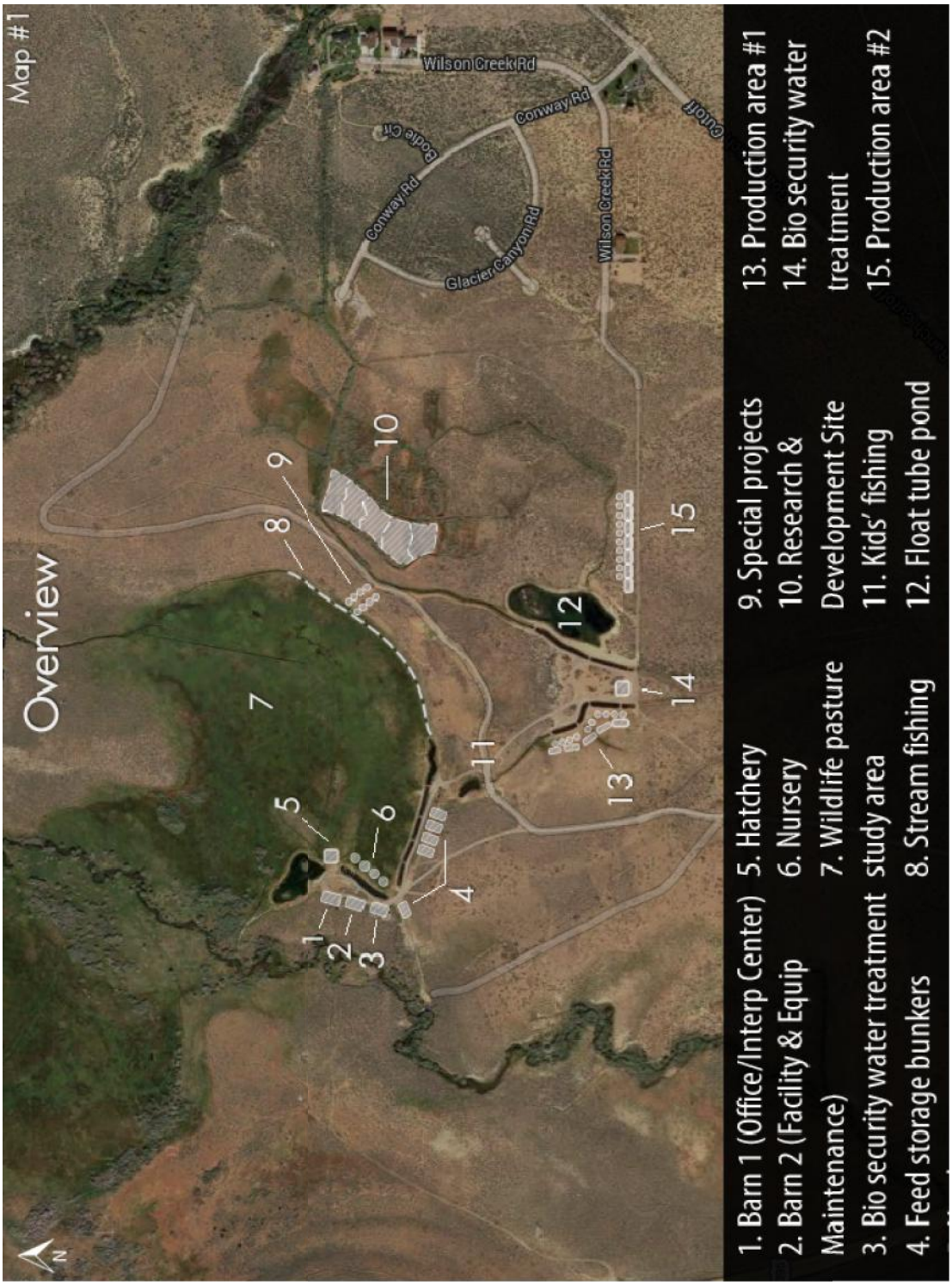
Hatcheries 1 - 8 raise Salmon or Steelhead
Hatcheries 9 - 21 raise Trout

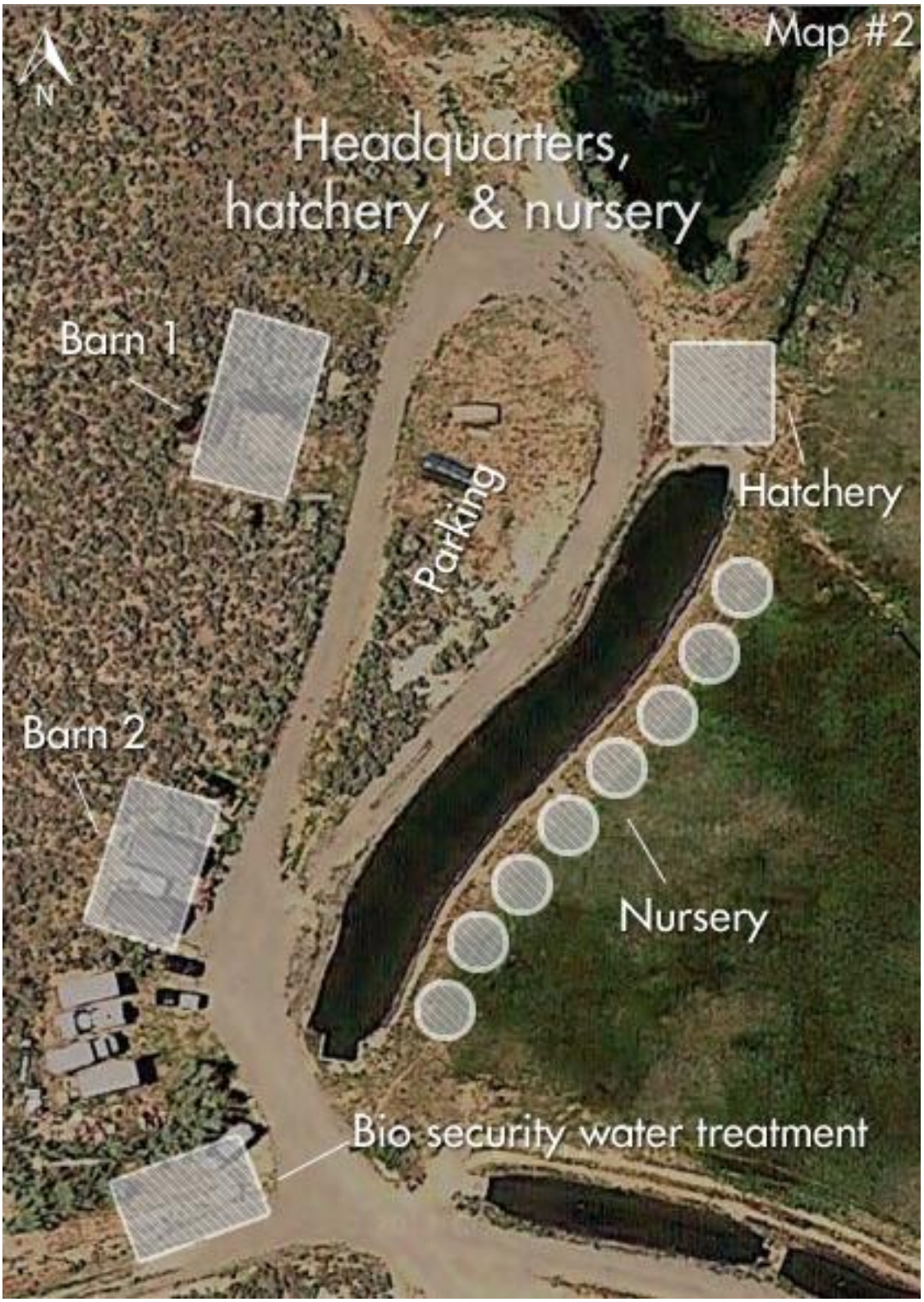


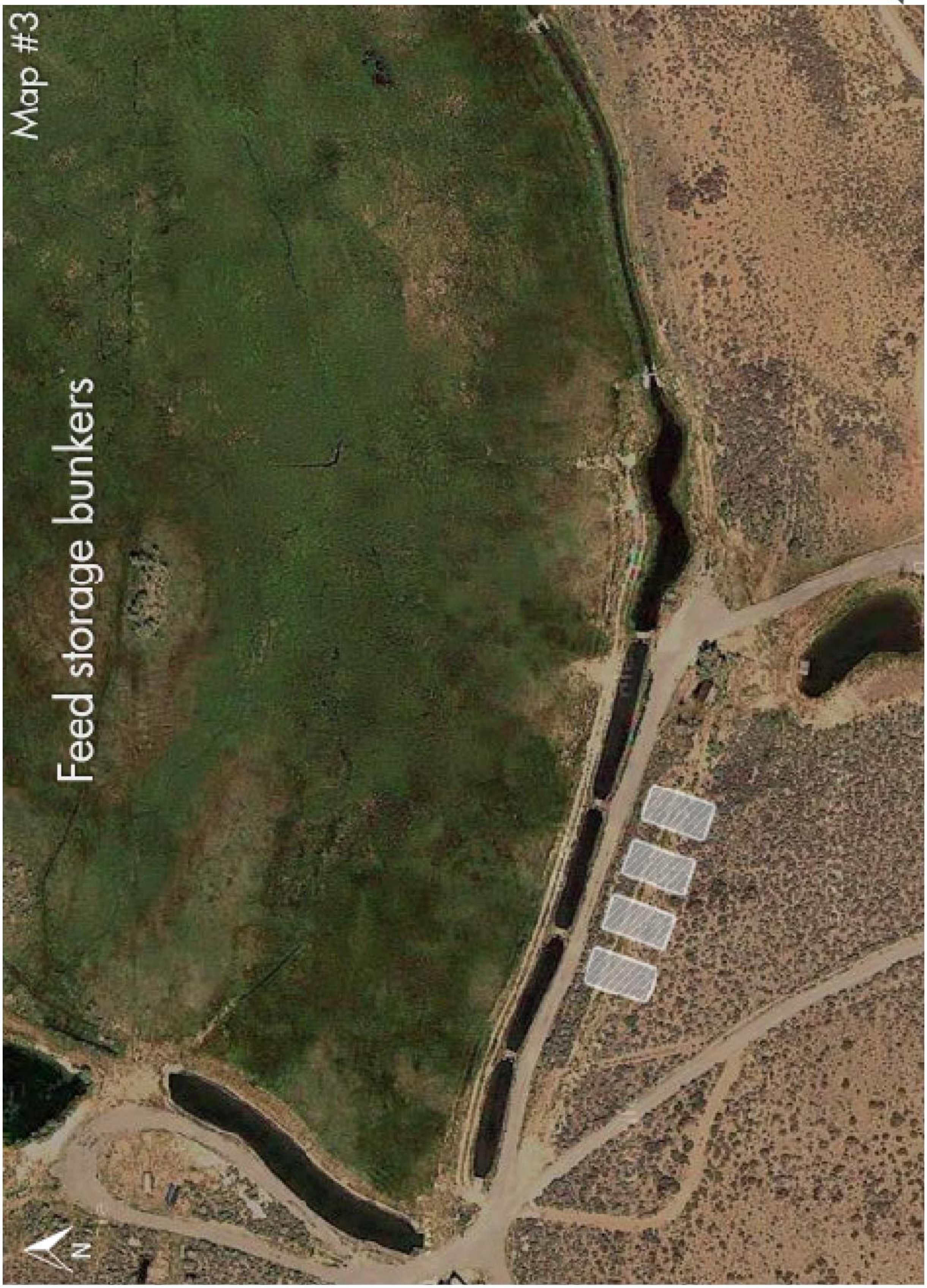
1. Iron Gate Hatchery
2. Mad River Hatchery
3. Trinity River Hatchery
4. Feather River Hatchery
5. Warm Springs Hatchery
6. Nimbus Hatchery
7. Mokelumne River Hatchery
8. Merced River Hatchery
9. Mount Shasta Hatchery
10. Darrah Springs Hatchery
11. Crystal Lake Hatchery
12. American River Hatchery
13. Silverado Fisheries Base
14. Moccasin Creek Hatchery
15. Hot Creek Hatchery
16. Fish Springs Hatchery
17. Mount Whitney Hatchery
18. San Joaquin Hatchery
19. Kern River Hatchery
20. Fillmore Hatchery
21. Mojave River Hatchery

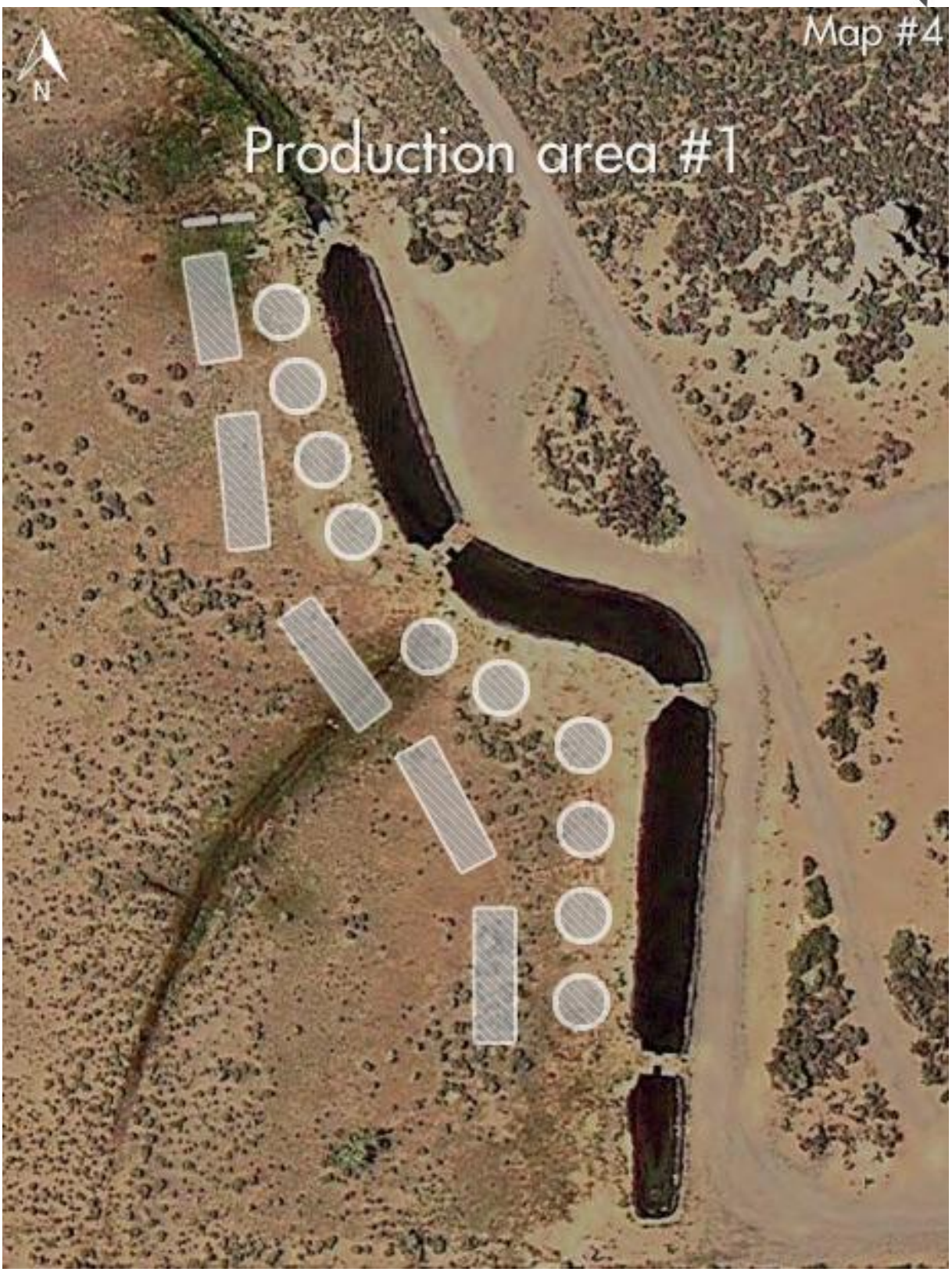
Maps

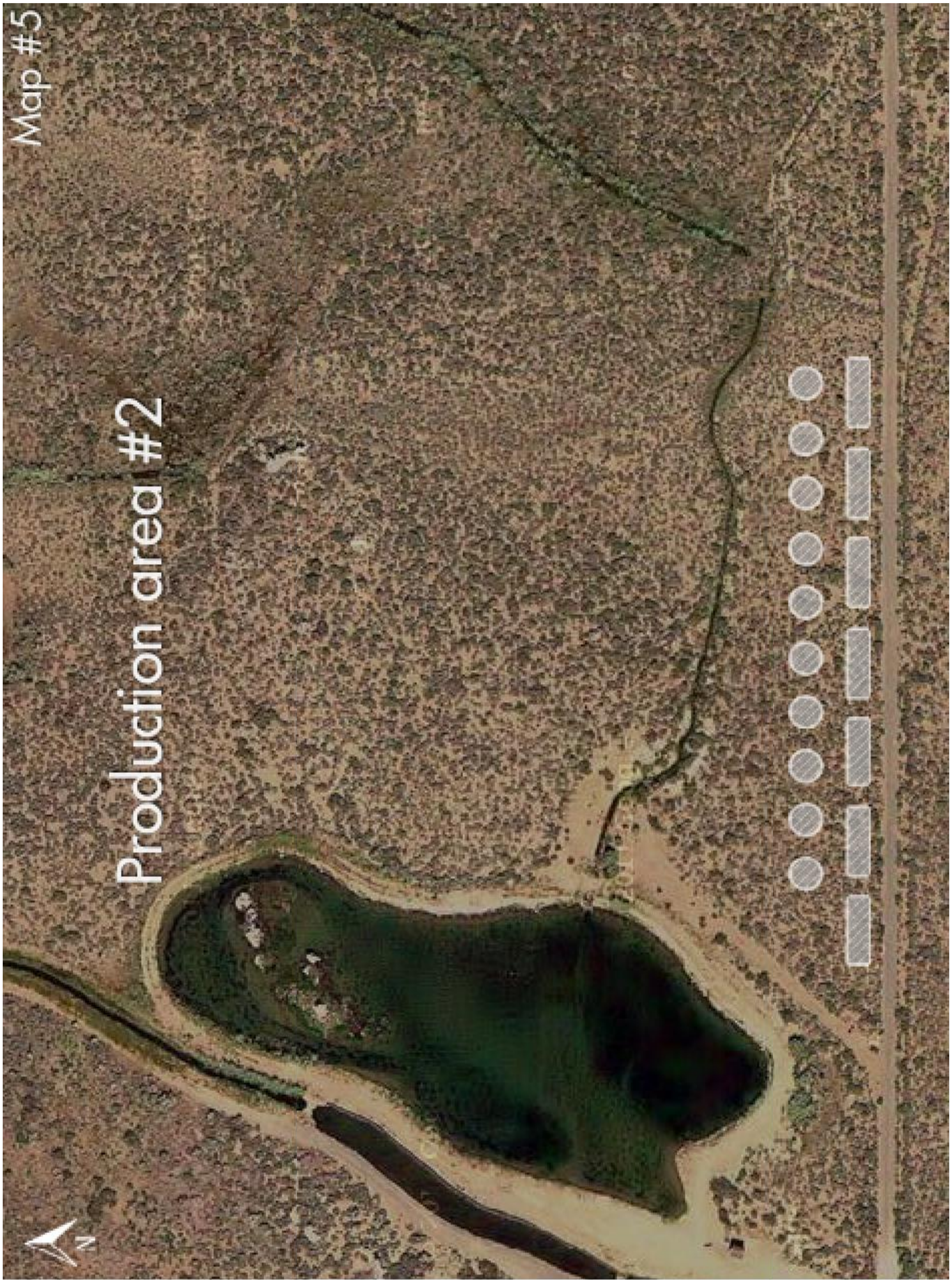
Maps show the general location (footprint) and size of improvements and project areas. Precise locations and sizes will be developed according to actual design and function. Where both raceways and tanks are depicted, both may be recommended or just a single culture method may be employed. Numbers and sizes of raceways and tanks are approximate and all areas are not to scale.




Map #2
N
Headquarters,
hatchery, & nursery
Barn 1
Parking
Hatchery
Barn 2
Nursery
Bio security water treatment

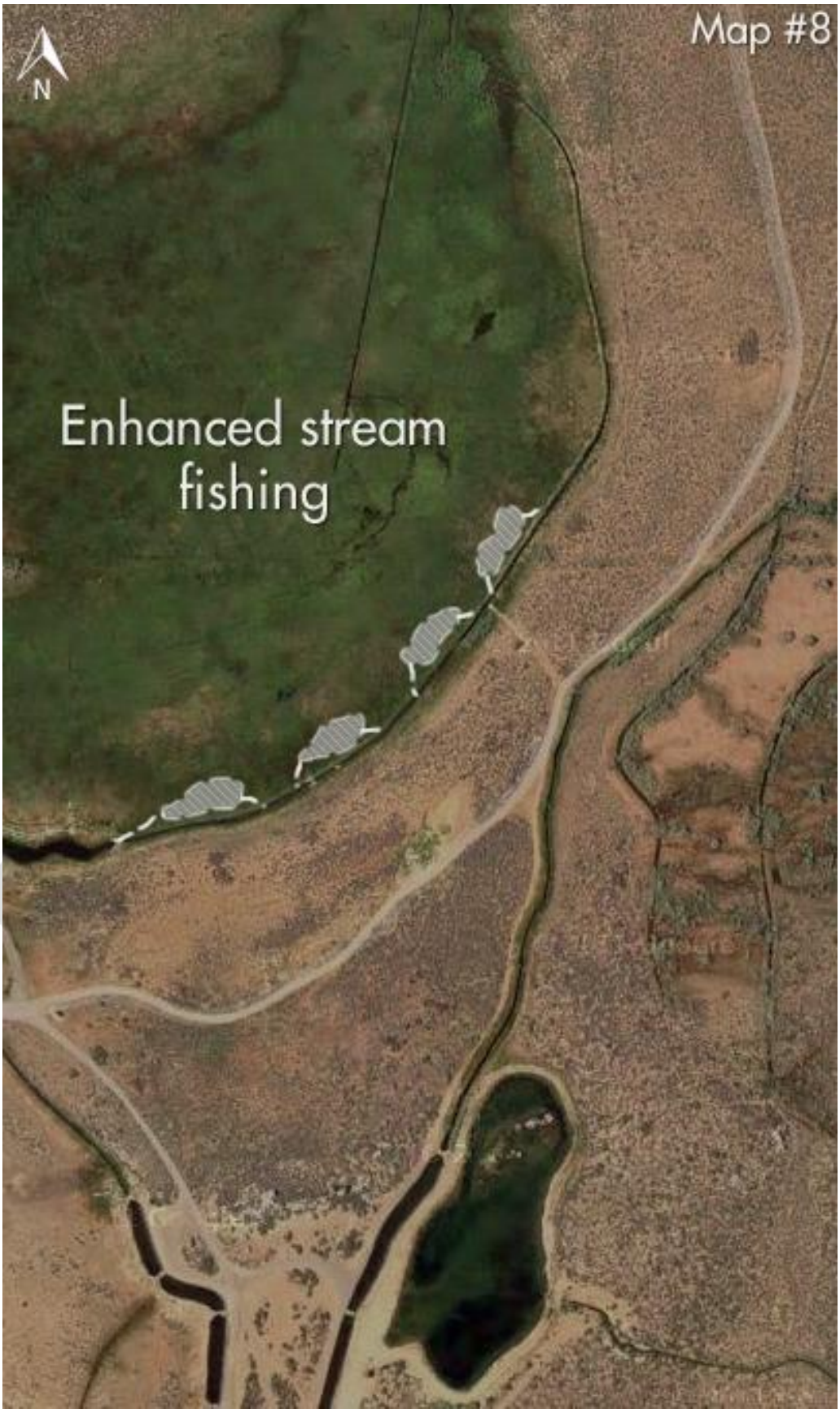

Map #3
Feed storage bunkers
N

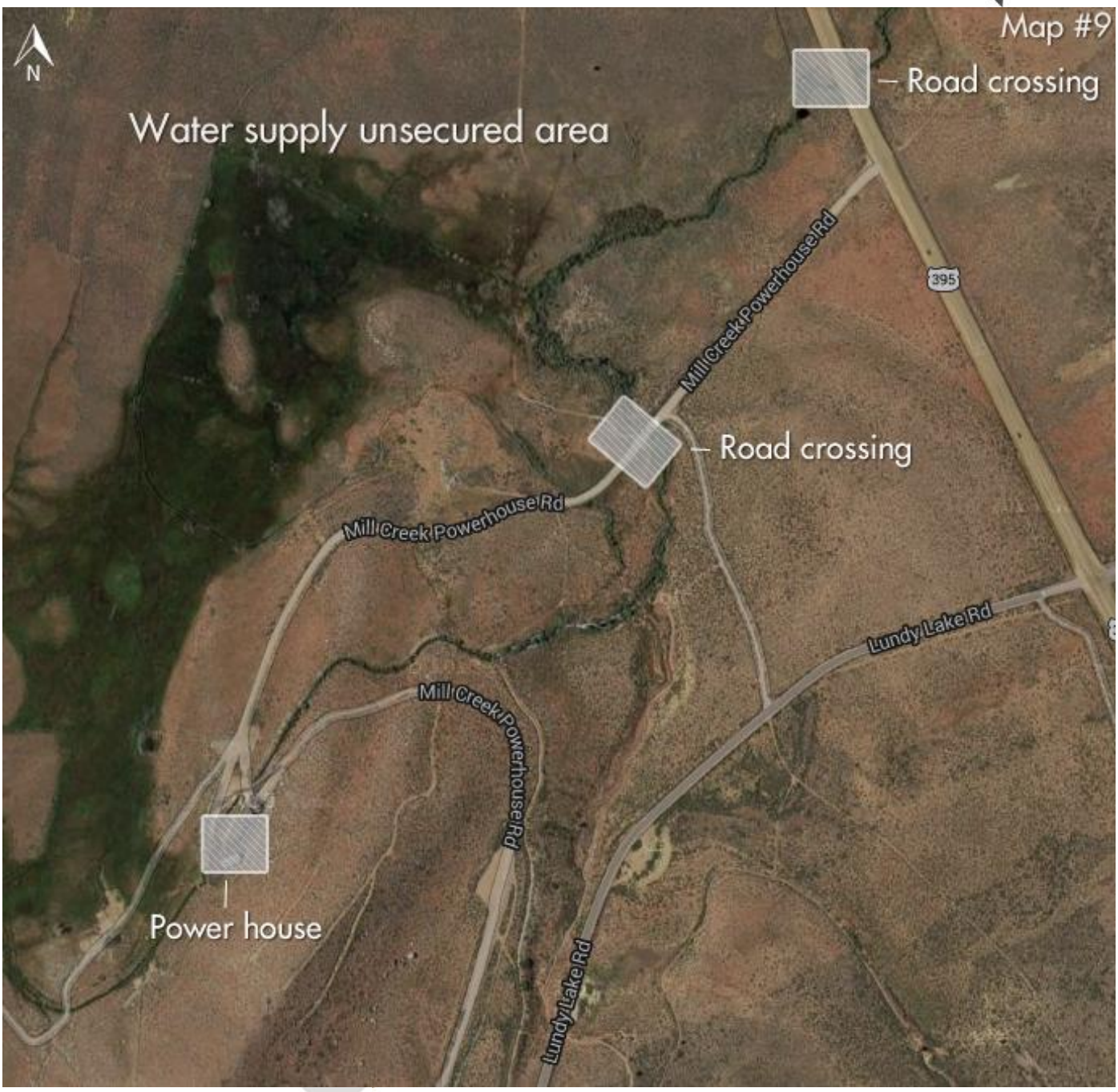

Map #4
N
Production area #1


Map #5
Production area #2
N


Map #6
N
Special projects area
Recreational stream fishing
Habitat
Fish rearing tanks
Research &
development


Map #7
N
Habitat
Production area #2


Map #8
N
Enhanced stream fishing


Map #9
N
Road crossing
Water supply unsecured area
Mill Creek Powerhouse Rd
395
Road crossing
Mill Creek Powerhouse Rd
Lundy Lake Rd
Mill Creek Powerhouse Rd
Power house
Lundy Lake Rd